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ABSTRACT

A study was conducted to evaluate the impact of the Associate Degree Program for Traffic Engineering Technicians (TET's) offered at three community colleges on students' subsequent job performance as technicians. Data were collected by means of personal interviews and telephone interviews with 81 students, their primary instructors, and their immediate job supervisors. Results indicated: (1) 29 students were employed as TET's while 20 students were employed in a highway-related field; (2) 7 students who had received the associate degree were working directly in highway-safety areas; (3) supervisors indicated a generally restricted job market for TET's; (4) students experienced no significant salary increases as a direct results of the program; (5) the majority of the students felt the program improved their job ability; (6) the majority of the students were satisfied overall with the program; (7) students trained in the program required less on-the-job training than those not in the program; (8) supervisors identified communications skills as a high-priority supportive course; (9) the majority of the participants felt that a bachelor's degree was necessary to advance or to get a better job. (JDS)

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THE PENNSYLVANIA STATE UNIVERSITY

ANALYSIS OF ASSOCIATE DEGREE PROGRAM FOR TRAFFIC SAFETY TECHNICIANS

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Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
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March 1976

P. T. I.

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ANALYSIS OF ASSOCIATE DEGREE PROGRAM FOR TRAFFIC SAFETY TECHNICIANS

J. K. Shimada

FINAL REPORT

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Federal Highway Administration
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16. Abstract

The objective of the project was to evaluate the impact of the Associate Degree Program for Traffic Technicians on the students' subsequent job performance as technicians. The program was conducted at Lansing Community College, Community College of Denver, and Longview Community College.

Data collection was accomplished through the use of personal and telephone interviews with the students, their immediate job supervisors, and the primary instructors of the academic program. The data consist of responses to "questions," regarding the adequacy of the program, the work performance of the students, and related aspects.

Within the constraints inherent in the program and data, subjective inference is made for various aspects of job performance and skills as influenced by the degree of program involvement.

The results generally indicate that effective training was provided for both the entry-level and experienced students. The program provided the "tools" necessary in traffic engineering work, and increased job awareness and interest.

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Chapter One

INTRODUCTION

As reported in Korim (1972) and Korim (1973), the American Association of Community and Junior Colleges (AACJC) tested and revised a two-year academic program designed to develop traffic engineering technicians in a National Highway Traffic Safety Administration Project. The program was offered at Lansing Community College (at Lansing, Michigan), Community College of Denver (at Red Rocks, Colorado), and Longview Community College (Lee's Summit, Missouri). For brevity, the schools are hereafter referred to as, respectively, LACC, CCD and LOCC. The findings of that project dealt primarily with the adequacy and the development of the program content. A follow-up study was recommended to evaluate the impact of the academic program on the students' subsequent job performance. That recommendation is the purpose of the present project entitled "Analysis of Associate Degree Program for Traffic Engineering Technicians" reported here.

Objective and Scope

The objective of the project was to determine the effectiveness of the academic program, held at the three colleges, in terms of the students' subsequent job performance and activities. Responses from as many students who could be located and interviewed are included in the report findings. Emphasis, however, is placed on those students subsequently employed in the traffic or highway fields.

A detailed evaluation of the program content, course by course, is not an objective, since it is reported in the previously cited references. Instead, student and instructor evaluations of the program are reported here in more general terms.

Methodology

The method consisted of four major steps. First, the data sources had to be identified and located. Contact information was obtained for the students who enrolled in the academic program developed in the AACJC project, their immediate job supervisors, and the primary instructors of the

program. Second, the pertinent interview information items needed to evaluate the program and employment performance were identified. The third step was to administer the personal and telephone interviews which were the media for obtaining the necessary information items. The last task was to analyze the interview data. The discussion below describes the project methodology in detail, and in particular the conditions under which the interview development and analysis steps of the project were designed.

Identification and Location of the Respondents

A preliminary list of students was obtained from the project files of AACJC. Other students were added to the list based on information provided by college administrative personnel.

Obtaining locational data was then attempted for each student. Unfortunately, several problems were encountered, which resulted in a loss of 30 students. Some of the problems were misspelled names, lack of up-to-date information (addresses, telephone numbers, etc.) on the student, and unlisted telephone numbers.

The following were the sources investigated for obtaining the student locational data.

- College administration personnel
- Fellow students
- City directories
- Telephone directories and operators
- Instructors
- Students' families
- Neighbors at last known address
- Motor vehicle agencies

With contact information available, the students were contacted to verify that they enrolled in the program and to obtain employment information. Identifying the supervisors through this information was accomplished with no difficulty.

Development of the Interviews

Data requirements were identified in terms of enrollment and academic and job performance for the students, supervisors, and instructors. These requirements were then transformed into a series of questions designed specifically for the student, supervisor, or instructor. This resulted in four sets of interview questions--two for the student group

and one each for the supervisor and instructor. The Types 1 and 2 students were given the same interview.

Various considerations were made in developing the interviews. The extent of coverage in the student telephone interviews was balanced with the time necessary to complete the interview. This consideration did not result in the omission of pertinent information items.

To avoid biasing the responses, the format of some questions was open-ended, particularly in areas which were exploratory in nature. All of the multiple-choice questions involved some form of ranking.

Early consultation with experts in the field of education-job performance evaluation identified the severe limitations of the data. Statistical requirements such as sample size and a control group were not met, thus limiting the statistical test options available. These early observations resulted in the experimental design adopted.

Applicability of particular questions was, of course, considered. While the development of the supervisor and instructor interviews were rather straightforward, the design of the student interview was complicated by the various types of students. An obvious dichotomy existed between the students working in the highway field and those who are not. Another dichotomy exists in the former group--students working as traffic engineering technicians (abbreviated herein as TET) and those who are in other positions in transportation. This last distinction was not made in developing the format of the interviews, but is adopted in the analysis of Chapter Three. Thus, there were four sets of interviews (see Appendix C) for five groups of respondents who are characterized below.

- Student Type 1--Student currently employed as a TET. (Student interview)
- Student Type 2--Student currently employed in the transportation field but not in traffic engineering. (Student interview)
- Student Type 3--Student not currently employed in the transportation field. (Student Type 3 interview)
- Supervisor--Immediate job supervisor. (Supervisor interview)
- Instructor--Primary instructor, taught several of the courses. (Instructor interview)

Personal and Telephone Interviews

Each of the three localities--Lansing, Michigan; Denver, Colorado; and Kansas City, Missouri--was visited to conduct personal interviews and obtain locational data for some students. Approximately half of the 81 students identified and located, all supervisors, and all instructors were interviewed during the site visits. Based on the experience of the early personal interviews, minor refinements of the interview format were made.

During the personal interviews, approval was obtained from the student to utilize his academic transcript. For the telephone interviews, this approval was in the form of a transcript release statement which was mailed to the students along with a "primer" for the interview. The "primer," consisting of pertinent questions and subject areas depending on the student type, was intended to minimize the time needed to conduct the interview. Upon receipt of the "package" the student was requested to sign and return the release form if he approved and notate the time, date, and telephone number he desired for the telephone interview. (This return mailing also informed the project staff that the students had received the "package.") The signed transcript release forms were sent to the colleges by the staff to obtain copies of the students' transcripts.

A major effort went into obtaining locational information of the students prior to the scheduled start of the telephone interviews, particularly during the site visits. However, a 100 percent sample could not be obtained, mainly because some students had left the various locales.

As was expected, there was a general resistance to returning the transcript release forms for various reasons. A number of students erroneously thought that they personally had to acquire a copy of the transcript from the colleges or that they had to answer the questions and return the "primer." This was anticipated and every effort was made in the "package" to give clear and concise instructions. Follow-up calls were also made to investigate the status of the "package" for non-respondents. These efforts minimized the number of students who could not be interviewed.

It should be noted that the personal and telephone interviews were conducted with little difficulty owing to the cooperation of the students, supervisors, and instructors. While the length of the interviews varied between 15 and 75 minutes, all of the respondents appeared to be candid and answered all questions in detail.

Analysis of the Responses

Prior to the analysis, the responses were coded for data handling through automatic data processing. "Statistical Package for the Social Sciences," a computer program, was used to minimize data manipulation time and insure accuracy of the results.

The data consists of all the responses from the interviews. These responses are viewed as variables of interest and are used individually and collectively in the analysis to evaluate the program's effects on subsequent employment and the program's general content.

Due to weaknesses in meeting some comprehensive statistical requirements, the manner in which the variables are used in the analysis is basically through subjective characterizations and comparisons. Thus, the results of this analysis are mainly inferences regarding program effects or content. Conclusions are based on a synthesis of these inferences.

Chapter Two

GENERAL DESCRIPTIONS OF THE RESPONDENTS AND VARIABLES OF INTEREST

This chapter acquaints the reader with the various types of respondents and their characteristics of interest. It is important to note that the students do not constitute a homogeneous group. They vary by college or program attended, number of courses enrolled, intent to acquire an Associate Degree (A.D.) in Traffic Engineering, career goals, reasons for enrolling in the program, and other characteristics. These variables will be examined in detail in Chapter Three.

Background of Respondents

Students Employed as TETs (Type 1)

Of the 81 students interviewed, 29 students, or 36 percent, are now currently employed as Traffic Engineering Technicians (TET). (It should be noted that the actual total enrollment in the program was approximately 111 students.)

Referring to row one of Table 1, the reader can see the number of Type 1 students from each of the three schools. The number in parentheses represents the number of entry-level students, i.e., students with little or no background in traffic or highway engineering prior to enrolling in the Academic Program. Of the 29 Type 1 students, only 7 of them were entry-level students, while 22 had already been employed in traffic engineering (TE). These 22 students had from 1 to 22 years of experience in highway work.

Table 1. Number of Students by School

Student Type	Community College LACC	CCD	LOCC	TOTALS
1	21 (3)	4 (2)	4 (2)	29 (7)
2	15 (8)	4 (0)	1 (0)	20 (8)
3	6	7	19	32
Totals	42	15	24	81

Students Employed in a Highway-Related Field (Type 2)

Of the 81 students interviewed, 20 students were subsequently employed in a highway-related area other than traffic engineering, with 8 of these being entry-level students. The other 12 Type 2 students had from 1 to 15 years of experience in highway work.

Students Not Employed in a Highway-Related Field (Type 3)

Of the 81 students interviewed, 32 of them were not employed in a highway-related field. It is not unreasonable to assume that the 30 students who could not be contacted for interviews are of this type. Specifically, the instructors and students who completed the program were not able to recall the majority of these 30 students. The implication is that these students were not actively involved with the program or traffic engineering. A number of students were known as being employed in other areas.

While this indicates that about half of the 111 students are not employed in a highway-related field, it would be incorrect to conclude that the "failure rate" is "50 percent," since there are other factors involved such as the students' intentions to acquire an Associate Degree or their career goals. In fact, there are several students who just enrolled in one course to acquaint themselves with the traffic engineering discipline and had no intention of working as a TET.

Supervisors of Type 1 Students

Seventeen supervisors were interviewed, 6 of whom supervised more than one Type 1 student of the 29 of interest here. Each of the 29 Type 1 students' supervisors was interviewed, thus evaluations for all of the students employed as TETs are included in the analysis.

Instructors

Five instructors as identified below were interviewed. These instructors, besides carrying the major teaching load of the program at each college, were also responsible for the college selection, course development, and student advising.

. Mr. Frank DeRose at LACC
Manager, Grants Administration
Bureau of Urban and Public Transportation
Department of Highways and Transportation
Lansing, Michigan

. Mr. George Allen at CCD
Deputy Director of Traffic Engineering
Department of Public Works
City and County of Denver
Denver, Colorado 80202

. Mr. Harry Skinner at CCD
Traffic Operations Engineer
Federal Highway Administration
Bldg. 50, Federal Center
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. Mr. Gerald Brickell at LOCC
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8301 State Line Road
Kansas City, Missouri 64114

. Mr. Edward Mulcahy
Johnson, Brickell, Mulcahy & Associates, Inc.
Suite 105
8301 State Line Road
Kansas City, Missouri 64114

Variables of Interest

In determining the effects of the program, it is essential to stratify the students since differences exist not only among the three types, but also within a specific student type. For example, one variable is the student's number of years experience in highway work as discussed in the section above. In comparing the job performance of Type 1 students, it would be incorrect to group entry-level students with students having 10 years of experience.

The purpose here is to generally describe the nature and role of these variables, and not to define each one as they are discussed in detail in Chapter Three. All the variables provide some specific information regarding the students' appraisal of the program's effect on their subsequent job ability. In contrast, some variables additionally provide a basis for comparing groups of students. One example of these variables is the students' reasons for enrolling in the program. An informative comparison based on this variable may be made on the grade point averages of students intending to get a job as a TET against the average of those who were investigating traffic engineering.

The utilization of the variables is basically subjective; since the opportunities for statistical analysis are limited

by small sample sizes. The analyses are based on preconceived relationships--the existence of an effect and trend--between certain variables. Experience, for example, is assumed to have a "positive" effect--that is, the more experienced student will likely have a better job or academic performance. Finally, it is important to realize that the magnitude of the effect is impossible to assess with reasonable statistical reliability and is not within the scope of the project.

Table 2. Variables of Interest

General

Community College
Respondent Type

Student-Related

Student Type by Enrollment
Work Type Prior to Program
Position and Level Prior to Program
Salary Prior to Program
Career Goals Prior to Program
Years Experience in Highway Field
Reasons for Enrolling in Program
Tuition Refund
Continuation Without Refund
Intent to Acquire an A.D.
Receipt of A.D.
Other Degrees Awarded
Grades for T.E. Courses
Career Goals After Program
Position and Level After Program
Salary After Program
Advice for Other Entry-Level Students
Reasons for Not Enrolling in Other Courses
Seek Employment in T.E.
Accept a Position in T.E.
Enroll in Program Now With Financial Aid
Preferred Types of Financial Aid
Supervision
Evaluation of Quality, Amount of Work for Student
Knowledge of T.E. Concepts
On-the-Job Training Required
Improvement of Job Performance
Evaluation of Student on Adequacy of Program Objectives
Larger Responsibilities
More Training Required
Attainment of Maximum Level and Salary
Need for More TETs

Table 2. Variables of Interest (Continued)

Program-Related

Evaluation of T.E. Courses by Students
Evaluation of Supportive Courses by Students
Received Training
Improvement of Job Ability
Equipped to Supervise
Adequacy of Teaching Aids
Adequacy of Laboratory and Field Work
Adequacy of Presentation of Material
Adequacy of Upgrading Experienced Personnel
Advanced Promotions
Ranking of Program Objectives by Students and Supervisors
Increased Interest in T.E.
T.E. as a Rewarding Area

Instructors

Problems in Program Development, Execution
Feedback and Retrospective Evaluation
Work-Study Course
Comparison of Students by Work Experience

Chapter Three

DISCUSSION OF RESULTS

This chapter describes the results of the analysis performed on the various variables of interest for the students and their supervisors and the responses of the instructors. The major objective of the analysis is to determine the effects of the program on subsequent employment while considering the possible effects of other factors, such as the students' career goals. The evaluation of the adequacy of the program content by the students and instructors is also discussed.

Generally, the results of the analysis are in the form of percentages of students who have certain characteristics; e.g., the percent of students who received their A.D. and held to be "above average" in specific job performance variables. It should be noted that in some cases responses to various questions were not available or not applicable. As a result, a number of the reported findings are not based on the total sample sizes as indicated in Chapter Two.

Program Effects on Subsequent Employment

Various aspects of the academic program and the students' subsequent employment are investigated. The role of the program in the students' job activities is identified with particular emphasis on highway safety. The manner in which the financial aid affected (and perhaps will affect) enrollment in the program is discussed. For students working as TETs, analysis is performed on various aspects of their overall job performance responsibilities, promotion and salary in relation to the program.

Types of Job Activity

(1) Highway-Safety Activities

Of the 29 TETs interviewed, only 7 students who received the Associate Degree are working directly in highway-safety areas. Their work in these areas include spot improvement studies (investigation, analysis, recommended remedial measures, and their implementation), area-wide safety improvement programs (route projects, signing,

marking, and traffic control), identification of hazardous locations utilizing accident records, construction safety zones, and other areas in the Federal highway safety programs.

Differences in the scope of activity exist between specific individuals. Mainly, the differences are a result of the varying safety responsibilities of the agency. For example, state transportation departments have different responsibilities than local municipal departments. Another reason for the difference in acivity is the specialization required by the larger agencies. For example, a technician in an accident surveillance unit of a state agency has more specialized duties than a technician working in the traffic unit of a city or small municipality. Experience in the area is another reason for the difference in activity. In fact, 3 of 7 were directly working the highway safety prior to their enrollment in the TET program and have supervisory duties.

All 3 experienced traffic safety technicians rated the program a 4 on a scale of 1 (low) through 5 (high) when asked if they believed the program was adequate in preparing a person with no experience for work in highway safety. The scale of 1 through 5 was used in several questions.

The remaining 4 students with no experience in highway safety rated the program as follows: two 3s, one 4, and one 5, "averaging" slightly below "good," for the question concerning whether they believed the program adequately prepared them to work in safety-related activities.

When asked for their recommendations toward improving this aspect of the program, a number of them emphasized the specific locale in view of the technician's duties. Another recommendation is the need to detail the relationships of various aspects of T.E. with highway safety.

(2) General Traffic Engineering Activities

There are 7 Type 1 students involved in safety-related functions who have not received an Associate Degree. Thus, these students were not included in the above discussion but are included in this listing. Depending on the degree of specialization in their unit, students generally have a wide range of T.E. duties. Besides those mentioned in highway safety, these duties include signal systems (design, installation, and warrants), traffic surveys and studies, geometric design (capacity analysis, design layout), and traffic control devices (signing and marking) programs. Although "safety" may not be the primary objective in these activities, the safety of our transportation systems is certainly enhanced by them.

(3) Program Effects on Specific Job Type

Of the 49 students presently working in the highway field (Types 1 and 2), 15 of them were not previously doing so. Of these 15 students, 7 (47%) of them felt that the Associate Degree or courses they completed helped them get a job in the highway field, while 8 (53%) of them felt otherwise. Only 6 of the 15 students received degrees and of these 6, five felt that the degree did help them acquire a job in highway work.

Seven of the 15 students not previously employed in the highway field are Type 1 students (TETs) of which 5 strongly believed that the program did help them get a job as a TET. Since only 3 of these 5 received A.D.s, the remaining 2 students felt that simply having been enrolled in the program helped them. It should be noted that of the 15 entry-level students working in the highway field, only 4 received the A.D.

(4) Other Factors Affecting Specific Job Type

In addition to the program, there were other factors which had some effect on the students' subsequent job types. One of the obvious factors is that 37 students out of the 81 students already had positions in the highway field. Three have since left the field resulting in 34, the sum of Type 1 and 2 experienced students, now working in the highway field.

While there are only 7 entry-level students employed as TETs, only 8 of the 44 entry-level students definitely knew they wanted to become a TET. The 44 entry-level students are comprised of the 15 Types 1 and 2 entry-level students and 29 Type 3 students who were not employed in a highway-related field. It should also be noted that only 3 of the 7 TETs definitely knew they wanted to become a TET, and eventually did receive the A.D. As would be expected, the personal goals of the students played an important role in the apparently low number of entry-level students now employed as TETs.

There are 32 Type 3 students of whom only 3 received A.D.s. There are 15 entry-level students now employed in the highway field, yet only 4 received A.D.s. A reasonable question is "Why aren't the 3 with degrees employed?" Two of the three students were employed in the traffic field, but left the field because of salary considerations. The last student was not able to find a TET position in his locale. In fact, a number of respondents emphasized the lack of employment and salary opportunities.

Indeed, the lack of openings and "low" salary levels were judged by an instructor at LOCC to be one of the reasons some students left the program before finishing. Knowing that two students had successfully found TET positions without an A.D., one student concluded that the A.D. would not be a consideration in his qualifications. With little existing prospects for employment, he felt that continued studies in the field would simply amount to a "waste of his time."

Another indication of low employment opportunities is that the instructors did not know of any formal recruitment or job interviews for the students. In fact, the majority of the instructors made several attempts to personally arrange for positions for the students.

The 16 supervisors of the Type 1 students were queried as to the need for more technicians in their units. (The transcript for one of the Type 1 students was not available, thus his and his supervisor's responses are excluded. As a result, there are 16 supervisors instead of 17, as previously indicated.) One third felt the unit did not require additional TETs. The remaining two-thirds felt the workload justified additional TETs, but there were few or no available open positions. When asked for the specific number of TET openings, only two supervisors said there were one or two openings in their units.

Another factor may be that LOCC dropped the TET program subsequent to the original research project. Four students did plan to continue their studies in traffic engineering technology.

(5) Synthesis

The low number (relative to the original total) of entry-level students now employed as TETs was a result of many interactive factors besides the program, such as the students' motivation, interest, and career goals. Local factors such as employment opportunities and salary levels also influenced the students' enrollment and continued interest in the TE field. No definite statement can be made regarding the role of the courses or A.D. in the overall employment selection process as viewed by the various agencies. In some cases, students without A.D.s were hired, and in other cases, students with A.D.s were not hired.

The evidence suggests that the program generally aided the students' employment in TE. The majority of students who received the A.D. in TET felt that the degree did help them get a job in TE.

It is difficult to specify the impact of the program on highway-safety activities in overall terms since other factors such as agency manpower needs, agency responsibilities, and job experience confound the analysis. However, it was found that only 7 students who received their A.D. are working directly in highway safety. Both the experienced and entry-level personnel rated the program "above average" on the criteria of adequate preparation for work in highway safety.

Highway safety topics should be incorporated in the program with emphasis on its relationships to various aspects of traffic engineering. Another observation by the respondents was the need for pertinent safety topics for the specific locale.

Financial Aid

The role of the financial aid cannot be ignored. It is an important aspect of the program which had an impact on the enrollment in the courses. One instructor indicated that the stipend was an important reason for some students' enrollment in the program.

Of the 81 students interviewed, thirty students received tuition refunds under the original research project. An additional 26 students received a partial or total reimbursement for the courses completed from their employers (state or local agency). The remaining 25 students stated that they did not receive any refund.

The impact of the financial aid on the enrollment was its attraction to students uncommitted to a firm career goal. Evidence of this attraction is that 41% of the Type 3 students who did receive the stipend felt that without it, they would not have enrolled in the program. The implication of this is that the free tuition drew them into the program rather than the attractions of TE itself.

Of the Types 1 and 2 students who wanted to advance in the highway field, a full 32% were either not sure or would not have enrolled in the program without the stipend. Thus, even with other "strong" motives to do so, a rather large percentage of students were either enabled or enticed to enroll in the program by the financial aid.

Job Performance and Responsibilities of the Type 1 Student

A basic hypothesis in this analysis is that exposure to the program, represented by the number of courses completed

and the receipt of the Associate Degree, had some effect on the students' subsequent job performance. The analysis "tests" this hypothesis in a subjective fashion by comparing the job performance results of two groups: low and high degree of involvement in the program. There is good reason to suspect that the effects of other factors are present, e.g., the years of experience in the TE field undoubtedly has some effect on the evaluations of the students. Thus, other variables identified as relevant in the data are considered. The tabulations for some variables are omitted because of the resultant small sample sizes and/or the "weakness" in the confidence for certain comparisons. These analyses would certainly lead to unreliable indications at best.

The difficulty of identifying the effects of the program is compounded by the interrelationships among the variables of job performance, personal traits, promotion to responsible positions, etc. As a result, the various sections of this chapter are not mutually exclusive. The evaluations of the students' job performance as given by the supervisors follow.

(1) Supervisor Evaluations

Of 28 Type 1 students, 21 of them were rated either "above average" or "one of the best" based on the amount and quality of their work. (The transcript for one of the students was not available, thus the responses pertaining to him are excluded. As a result, there is a discrepancy with the student totals given in Chapter II.) However, when separating the students by their involvement in the program--receipt of A.D. and number of courses--there is no clear indication that a difference exists in their evaluations.

For example, three of four entry-level students who completed more than five courses were rated "above average," yet all five of the entry-level students who completed less than five courses were also rated "above average." (The reader should note the small group sizes as a major constraint in arriving at definitive findings.)

Of the nine entry-level students, only one student (with no A.D.) required on-the-job training beyond the normal familiarization with the unit's working, as evaluated by their supervisors. (To increase the sample size for entry-level students, the definition of entry-level was modified to include students with one year of experience or less in the field. This resulted in 19 "experienced" students and 9 "entry-level" students, or a total of 28 Type 1 students for whom transcript data is available.) The implication is that program-trained TETs are able to take on responsibilities

sooner. The supervisors also listed a number of on-the-job training procedures used in their agencies. Beyond the normal job experience, activities include regularly and irregularly scheduled in-house seminars, formal in-house training, and agency-sponsored outside education.

The supervisors were also asked whether the students required additional training for their jobs. While the comparison of entry-level groups by program involvement does not indicate any difference, the results for experienced groups does imply a positive effect of the program. Eighty percent of those students completing less than five courses were said to need additional training, while only 33 percent of those completing more than five courses were thought to need it. (The type of training is discussed in a later section.)

For the 22 students whose supervisors were able to respond to the query pertaining to any noticeable improvement in job performance following the program, a distinct difference exists between the groups by program involvement. For example, 50% of those students who received an A.D. were thought to exhibit improvement, while only 14% without the degree showed improvement. Similar results exist for the groups of low and high number of completed courses. The supervisors noted that the discerned increased interest and awareness by the students in the responsibilities of the unit. Because most of these students were already experienced in the field, the supervisors found it difficult to evaluate the improvement in terms of work performance.

Another variable which results in distinct differences between student groups is the supervisors' evaluation of the students' knowledge of traffic engineering concepts. Of those who were more involved in the program, 80% were felt to have a better knowledge compared to all other technicians, while only 60% of those less involved were evaluated as such. Similar percentages exist for the students with experience in the traffic field. Sixty percent of the experienced students with low involvement were judged to have better knowledge than other technicians, while 78% of the experienced students with higher involvement were judged as such.

The supervisors were also asked to evaluate the students based on the stated objectives of the program. The evaluation consisted of whether they felt the student was "strong, adequate, or weak" in the items that follow. A number of the supervisors were not able to evaluate their technicians because of their limited observations for certain items. (The following list comprises the general and specific objectives of the program as given in Korim (1972).)

1. Communication skills (oral and written).

2. A knowledge of the driver, roadway, and vehicle characteristics.

3. The ability to extract design information from manuals and apply it to specific problems.

4. A knowledge of data collection methods, tabulation, and analysis.

5. A knowledge of the operation and maintenance of traffic and control devices and equipment.

6. The ability to prepare sketches, engineering drawings and to use graphics for illustrative purposes.

7. A knowledge of highway capacity analysis.

8. The basic principles of traffic and highway engineering

9. An appreciation of the general concepts and principles of related fields--particularly urban planning and police traffic supervision.

While there appears to be an opportunity to relate specific courses to job performance through these objectives, the data do not permit it. In particular, the identification of the specific courses with the program objectives is questionable. Thus, the results of the evaluation are presented in summary terms.

A consistent result for all nine objectives is that few students were rated weak. (However, a number of entry-level students were felt to be weak in communication skills and their ability to prepare sketches.)

No experienced student with a high degree of program involvement was rated weak in any category. Moreover, when compared with the results for the experienced personnel with low program involvement, their distribution of the strong, adequate, and weak categories are "skewed" more favorably.

The entry-level students with high program involvement generally have the same ratings distribution as the experienced TETs with low program involvement. As more evidence,

one instructor, who is also a supervisor, felt that some entry-level students' work performance was comparable to that of technicians with five or more years of experience.

For all TET students, the students who received the A.D. were rated "strong" more times than those who did not finish the program. The typical difference is about 25% greater for those with the A.D.

For students who were hired after the program, their supervisors were asked whether they felt the students could handle larger job responsibilities in a shorter than usual time period. The results do not indicate any difference between students with different levels of program involvement.

(2) Student Evaluation of the Program

Of the 19 experienced TETs, 53% of them felt that the program improved their job ability while 37% believed that it did not. All of the students who received degrees felt that the program improved their job ability, while none of those who held the opposite opinions received their A.D.

The students' views are evenly split on the basis of whether the program did or did not equip them to take on supervisory responsibilities.

The students were asked to compare their academic training to their work experience by identifying specific T.E. areas in which they gained more from the program than from work experience. All of the students who enrolled in more than one course felt that they did learn various concepts they did not acquire from their work experience. The areas identified generally consist of the various T.E. course topics outside their special functions. Similarly, the areas identified in which they learned more from work experience consist of areas which fall into their job speciality, e.g., control devices.

(3) Synthesis

The lack of definitive findings regarding the program's impact on subsequent job performance arises from the lack of powerful measures to detect that impact. Based on the supervisor evaluations, students of both low and high degree of involvement in the program do at least "adequate" or better work.

Job performance (how well he does the job) is certainly dependent on the technician's grasp of technical concepts, work skills, job awareness, motivation, and individual traits (the "tools" he uses in doing his job). While the program may not have directly and measurably affected the job performance of students, it did so indirectly in terms of the preparation for their job. The indication of the analyses is that the program did provide the tools to both the entry-level and experienced students for their jobs as traffic technicians. For example, one indication is that entry-level students were able to take on job responsibilities sooner than what is usually expected. The experienced personnel were felt to have showed noticeable improvement in their job performance subsequent to enrollment or completion in the program.

Promotion and Salary

Salary and promotion are relatively easy to measure, but difficult to analyze because of factors other than the program. As expected, some students' salaries and position levels have increased, since they started the program. However, without a control group for comparison, it is practically impossible to accurately assess the effect of the program on these indicators given the inherent characteristics of the data.

A partial list of other factors are easily identified:

- Regulated promotion by time
- Availability of higher position levels
- Current position level
- Minimum qualifications
- Personal traits: abilities, intelligence, motivation, etc.
- Budgetary constraints.

(1) Promotion

Seventeen of the Type 1 students were technicians prior to their enrollment in the program. Eleven students were not, but were "promoted" to the position subsequent to the program. Their prior positions were draftsmen, student technicians, or entry-level and can be considered lower on the job scale.

While the job level designations vary by agency, the analysis is restricted to the change in job level prior to and after the program within the same agency. In general, Type 1 students were promoted in varying degrees.

What is the effect of the program on promotion? The answer to the question was sought by addressing the job level changes, the supervisors' evaluation of promotability, and the students' opinion of the program effects on their promotion, all with respect to the number of courses enrolled in and the receipt of the A.D.

There is no indication that a larger percentage of students who enrolled in a large number of TET courses or received the A.D. experienced larger changes in job levels. There are two possibilities why this resulted--either the program had no effect or the other factors listed above were much more "powerful." Evidence of the second possibility can be seen in the fact that all ten promoted students evaluated "above average" in terms of quality and amount of their work, while no student rated "average or less" was promoted. Recall that in the previous section that no program effect on work quality was found. Thus, the implication is that the personal traits of the students were a stronger influence than their involvement in the program.

Comparable results were found for the supervisors' evaluations of whether the student should eventually be promoted to the maximum technician level. There was no clear difference between those students enrolled in a larger number of courses and those enrolled in a smaller number, or between those who received and did not receive the A.D.

Because the maximum job levels often entail supervisory duties, the students were asked to evaluate whether the program equipped them to take on supervisory responsibilities. While 17% of all Type 1 students responded positively, 36% of those receiving the A.D. and only 6% who did not receive the A.D. thought so. The results indicate that the program provided a degree of training for a third of the students who did complete the program to work in responsible positions.

In evaluating the impact on their promotions, one-third of the students felt that the courses or program aided their advancement opportunities. While this fraction is low, an interesting result is that 31% of those students who enrolled in five or less courses felt that the courses did have a positive effect. Another point of interest is that nearly 30% of the experienced TETs felt that the courses or A.D. aided their promotional opportunities.

(2) Salary

In the analysis, comparisons of salary increases of the students by their involvement in the program, years of work

experience, changes in job levels, supervisors' evaluations of their job performance, and college were attempted. The last item is important because the program did not start at the same time at all three colleges. Unfortunately, the resultant sample sizes of the groups classified by those variables are too small for even a subjective comparison.

As a result, the following discussion is limited to the results of the student salary and program involvement comparisons. The table below provides the aggregate salary results of the Type 1 students whose salary figures were available:

Table 3. Number of Students by Percent Salary Increase

Percent Salary Increase	With A.D.	Without A.D.
0-30%	7	8
30-60%	2	4
60-100%	1	5
TOTAL	10	17

Only 30% of those students receiving A.D.s experienced a 30-100% increase, while 53% of those who did not receive the A.D. fall into the same category. Similar results were obtained for students based on the number of courses enrolled.

Needless to say, a better comparison would involve the salary increases of a control group, i.e., technicians who did not attend the TET program. Still, the comparison would be filled with effects of other factors inherent in the addition of a control group.

The supervisors were asked whether the student should receive the maximum salary available. Again, there is no clear indication that salary differences are based on differences in the involvement in the program.

The students themselves felt the program had little effect on accelerated promotion or salary increases. Only 2 of the 28 Type 1 students felt the program did accelerate their job and salary standing.

(3) Synthesis

Due to the inherent constraints of the data, scant findings are available for the program's effect on the students'

subsequent salary and promotion experience. About one-third of the students felt that their involvement in the program aided their opportunities for promotion, while a smaller percentage felt that the program actually accelerated their salaries or promotion.

However, there is no indication, based on the reported position and salary changes, that the program generally improved the students' promotional standings or salaries by degree of program involvement.

Evaluation of the Program Content

All of the instructors and students generally felt that the program content was better than adequate. Many of them specifically stated that the program was a pilot program, and evaluating it in that context, they would give it high marks.

The following discussion is a synthesis of their comments and evaluations of various aspects of the program. The instructors' observations of the various problems which they encountered in the development and execution stages of the program are summarized in the following section. For some perspective on the problems as they relate to the adequacy of the courses, the students' evaluations of the courses are then given.

Problems in the Program Development and Execution

A few prefacing remarks are warranted here. The following comments by the instructors and students are general observations, both negative and positive, of the program. To conclude that the program was ineffective based on the problems specified by the instructors would be unjustified. Their statements were in response to specific questions regarding the program and should not be taken out of context. The specified problems and their severity also varied by college.

Time and monetary constraints were the most significant problems. Further evidence of this can be found in Korim (1972) and Korim (1973). A related problem was the lack of a full-time staff to provide overall consistency and organization to the program. All of the instructors named in this report were not full-time instructors with the community colleges. Conflicting responsibilities in terms of time and manpower were a result.

Recruiting interested students was also a problem. The traffic engineering technician's job is not widely recognized by both entry-level students and the relevant agencies. The lack of manpower and funds limited the efforts to "sell" the program and discipline. It should be noted that the college personnel and the five instructors recognized this during the start-up period and voluntarily made personal efforts to recruit students.

The instructors unanimously felt that more practical or "hands-on" experience in traffic engineering for the students was needed. Related to this was the shortage or lack of classroom and field-work teaching aids such as signal controllers and traffic volume counters. Again, the instructors made special efforts to acquire this equipment for use in the program.

The development of the course content, while aided by various traffic engineering references, was hindered by the lack of literature specifically designed for the technician's function and job level.

With the enrollment of a significant number of experienced personnel in the courses, the courses were conducted in a manner different than if only entry-level students had been enrolled.

Adequacy of Course Content

While the effects of the problems cannot be quantified, some indication of their severity is available. The Type 3 group were asked to evaluate the manner in which their personal interests in T.E. were affected by the program. Two-thirds of them felt that the courses did increase their interest in traffic engineering, while only 8% felt that the courses did not increase their interest.

The Types 1 and 2 students were asked to evaluate the adequacy of the teaching aids, the amount of lab or field work, and the course presentation. Two-thirds of the 45 students (excluding those whose transcript data are not available) felt that the teaching aids were more than adequate. Approximately 11% felt they were less than adequate and 22% felt they were adequate.

Since not all the courses require field or lab work, as an estimate only students taking 5 or more courses are included in the following evaluation. Of these students, 50% felt that the amount of lab work was better than adequate, while 29% felt it was less than adequate, and 21% felt it was adequate.

In evaluating the presentation of the material, 80% of the Type 1 and 2 students felt that the presentation was more than adequate. Of the total, only 7% felt it was less than adequate, and 13% felt it was adequate.

An overall indication of the students' view of the program is the response to the question, "If a friend of yours were to ask for your advice on how to become a TET, what advice would you give him?" Approximately 61% of the students now employed as TETs would advise their friends to enroll in the Associate Degree program. Interestingly, 29% would advise them to earn a four-year degree instead, i.e., become an engineer rather than a technician. Ten percent had no opinion.

The majority of the Type 1 students felt that to advance in their current job or get a "better job," a four-year Bachelor's Degree was necessary. The inference is that additional training not resulting in a Bachelor's Degree would do little for their careers.

Another general indication of the students' feeling toward the program is the response to whether they received the training they expected. The results are similar to those for the "advice" results above. A little over 69% of the Type 1 and 2 students felt that they received the expected training. Only 4% felt that the training received did not meet their expectations.

Sixty-five percent of the 23 experienced TET students felt that the program was better than adequate for the purposes of upgrading or review. However, 22% felt it was less than adequate and 13% felt it was adequate.

The disparity between the negative evaluations--4% for expected training and 22% considered inadequate for upgrading purposes--is the fact that over 30% of Type 1 students were not sure whether the training met their expectations. When they were asked the more "direct" question regarding adequacy for upgrading purposes, they responded in the negative sense.

The following course evaluations are not to investigate whether specific courses should or should not be in the program, but rather to report the relative interest in both the traffic engineering topics and supportive courses.

The Type 1 students were asked to name the traffic engineering courses (in which they enrolled) which they felt were "one of the best" and "one of the worst" in terms of the relevancy of the material to their job. The results of the responses, along with the number of students who enrolled in

Table 4. Type 1 students' evaluation of courses.

Course	Number of TET Students Who Enrolled	Who Felt It Was "One of the Best"	Who Felt It Was "One of the Worst"	College Offering Course
1. Introduction to Traffic Engineering	19	3	6	LACC, CCD, LOCC
2. Principles of Traffic Admin. & Safety	18	4	2	LACC, CCD, LOCC
3. Field Traffic Survey	17	5	0	LACC, CCD
4. Control Devices	23	13	2	LACC, CCD, LOCC
5. Traffic Studies	13	9	0	LACC, CCD, LOCC
6. Geometric Design	18	9	2	LACC, CCD, LOCC
7. Urban Transportation Planning	13	3	3	LACC, CCD, LOCC
8. Traffic Laws & Regulations	13	6	1	LACC, CCD, LOCC
9. Traffic Accident Investigation	4	2	1	CCD, LOCC
10. Model Traffic Ordinances	4	0	1	CCD

the courses, are given in Table 4. An obvious factor influencing the responses is their specific job functions. Note, for example, the relatively large number of responses in favor of the "practical" courses--control devices, traffic studies, and geometric design. In a related query, the course most often named as not being used on the job was urban transportation planning.

The Type 1 students were also asked to name the traffic engineering courses they omitted which would have been beneficial in their job. All of the courses were selected, except the introductory and model traffic ordinances courses, with no emphasis on any one course.

The accident investigation course was only offered at CCD and LOCC, for which there were eight Type 1 students. Four of them enrolled in the course. Of the remaining four, two felt that this course would have been beneficial.

Fifteen Type 1 and 2 students who received the A.D. were asked to name the supportive areas in which they want more training. Table 5 presents the results.

Table 5. Number of Students Selecting Supportive Areas for More Training

Course	Did Select	Did Not Select
1. Mathematics	9	6
2. Physics	2	13
3. Communication Skills	9	6
4. Drafting	9	6
5. Data Processing	4	11

For further insight, the sixteen supervisors were asked to name areas in which they felt TETs need more training. Despite the open-ended nature of the question, a nearly unanimous selection was communication skills. Report writing, oral communication, and letter writing skills were emphasized. Another area selected was problem solving--data collection, analysis, and development of remedial treatments. While most of the supportive courses were named, almost no traffic engineering areas were identified. Those areas which were

identified were basically the conceptual relationships with highway safety. For example, the impact of signing or traffic signals on traffic safety and how to evaluate that impact was specified.

The supervisors were requested to assign ranks to each of the nine program objectives as previously listed in the context of their unit's functions. Based on a statistical rank test, the responses differ "significantly." The inference is that a particular skill or knowledge may be important in some technician positions but relatively unimportant in other positions. Emphasis, therefore, on any specific or group of technician skills would be inappropriate.

Synthesis

While there were problems encountered in the execution of the program, the majority of the students were satisfied with the program. The adequacy of the programs is evidenced by the small percentage of Type 1 students who felt that various program aspects were less than adequate. The program was not perfect, but there is strong evidence that it was at least adequate in its major aspects.

The difficulty of "isolating" the adequacy of the academic program from other factors is clearly evident in the results of the "advice" question. A number of the technicians evaluated the job rather than the program by preferring the Bachelor's Degree rather than the two-year A.D. For those who do want to work as TETs, the program was recommended.

Designing the course material for both the entry level and experienced personnel needs was a difficult problem. The program, of course, is basically organized for the entry level student. Despite this, over three-fourths of the experienced TETs felt that the program was adequate or better for the purposes of upgrading technical knowledge.

Providing some insight into the technician's training needs, the supervisors emphasized the importance of communication skills and problem-solving techniques. The ability to evaluate the impact of highway projects on traffic safety and operations was also specified.

Chapter Four

FINDINGS AND CONCLUSIONS

As a preface, it should be noted that this study does not yield results with a statistical level of confidence or reliability. Rather, the results are replete with non-quantifiable effects (from various sources) making the drawing of definitive conclusions difficult. Thus, the conclusions discussed below are basically inferences as suggested by the findings of the previous chapters.

Findings

1. Of the four entry-level students who received the Associate Degree in Traffic Engineering Technology, three obtained highway technician jobs. Three are working directly in highway safety.

2. One-third of all the students in the program felt that the program aided their advancement opportunities.

3. All experienced technicians who received the Associate Degree (eight) felt the program improved their job abilities.

4. Six of the nineteen experienced technicians felt that the program aided their advancement opportunities.

5. Those traffic engineering technicians participating in the study program required less on-the-job training than those not trained in the program.

6. Participants experienced no significant salary increase as a direct result of the program, although two students felt the program did accelerate their job and salary standing.

7. Of the eight experienced techncians who received the Associate Degree, four exhibited improvements in job performance. Only one of eight experienced technicians who did not receive the degree showed such improvement.

8. Supervisors identified communications skills as a high-priority supportive course.

9. Seventeen of the twenty-nine participants now employed as technicians would encourage their friends to enroll.

10. Five of the eight experienced technicians rated the program better than adequate for up-grading or as a refresher.

11. The tuition refund was instrumental in enrolling about 40 percent of the students not employed in highway-related fields and about 30 percent of the students working in highway-related fields.

12. The majority of the participants feel that a Bachelor Degree is necessary to advance in their current job or to get a better job.

Conclusions

1. The program helped entry-level students to obtain technician jobs.

2. The technician's individual abilities played a greater role in promotions and salary increases than did the Associate Degree training.

3. The program was useful in bringing entry-level students abreast with experienced technicians with regard to their ability to perform.

4. The program enhanced the experienced technician's job performance and ability.

5. Financial assistance was beneficial in recruiting students for the traffic technician program.

6. The traffic engineering technician programs depend on the level of employment opportunity for their success.

7. Employment opportunities are limited and do not completely reflect the actual need for more traffic engineering technicians.

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